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(54) Title: CHOCOLATE CONFECTION			
(57) Abstract <p>A chocolate that contains a composite of surfactant/cellulose. The composite is made by the process of coprocessing the cellulose with a surfactant. The composite can be used as a bulking agent or functional formulary aid in low-moisture or in fat phase compositions.</p>			

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Chocolate Confection

5 This invention relates to new functional bulking and texturizing materials used as an ingredient in chocolate. More particularly, the invention relates to an improved chocolate containing a particulate coprocessed cellulose.

10 In this era of calorie consciousness in which many consumers are interested in reducing their calorie intake, particularly their fat intake, without reducing their food consumption, there is a need for reduced calorie food ingredients that provide bulk, but few, if any, calories. These bulking aids can be incorporated into specific foods to replace or otherwise reduce the amount of fat and/or other calorie source that would normally have been present in the food. Typically, although not always, these bulking aids preserve the texture of the food and the mouthfeel of the food and preferably enhance either the functionality of other food ingredients or the efficiency of the process of forming the foods.

20 Cellulose is one such material that has historically served as a functional formulary aid in a wide range of food applications. The use of cellulose as a non-nutritive bulking agent in food systems, especially in non-aqueous food systems, is limited by several characteristics of cellulose. These include an inherent chalky or other disagreeable taste, especially at high use levels; difficulty in forming a dispersion, which adversely affects its 25 mouth feel; and an adverse affect on texture or consistency.

30 The traditional approach to overcoming these limitations has been to coat the particulate cellulose with carboxymethyl cellulose, with a gum such as guar gum, or with some other hydrocolloid. Such coatings work with various degrees of effectiveness in aqueous systems; however, they do not tend to work well in systems containing little or no water.

35 This invention is directed to a novel particulate cellulose composite that is dispersible in a low moisture or in a non-aqueous system, such as chocolate. The composite can be designed, if desired, to provide good texture and/or to avoid the chalky taste of cellulose. It can serve as a bulking agent or it can be used to provide functionality

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The present invention is directed to a chocolate containing as an ingredient a composite of a particulate cellulose and one or more surfactant(s) in which the surfactant is adsorbed onto the surface of the cellulose, which composite has surfactant(s) with an HLB within the range of from 1 to 40. This composite can be made by coprocessing a particulate cellulose with a surfactant.

The term "cellulose" denotes a particulate cellulose that has not been coprocessed with a hydrocolloid or with a surfactant. Such a particulate cellulose includes microcrystalline cellulose (MCC), such as Avicel® microcrystalline cellulose, a product of the FMC Corporation; a cellulose powder, such as Solka Floc® cellulose powder, a product of the Fiber Sales and Development Corporation, a subsidiary of Protein Technologies; a fibrillated cellulose, a fibrillated microcrystalline cellulose, an attrited microcrystalline cellulose, an attrited fibrillated cellulose, and any other particulate cellulose or microcrystalline cellulose. Any cellulose source can be used. These sources include wood pulp, non-woody plant sources such as wheat fiber, soy fiber, cane, bagasse, sugar beet, cocoa, oats, and the like. The starting particle size may range from 1.0 to 500 micrometers (microns; μ), with a preferred range of 1 to 50 μ for most cellulose, and a most preferred range of from 1 to 20 μ . The shape of the particles may be round or spherical, rod-like, platelet shaped, or irregular. The preferred particle size and shape are determined by the particular end use, and the general considerations operative in such a selection are known in the art.

The term "surfactant" denotes a chemical compound with a calculable HLB (hydrophilic/lipophilic balance) within the range of from 1 to about 40. A surfactant has at least two types of moieties, a hydrophilic moiety and a hydrophobic moiety. Although HLB was developed as a means for categorizing emulsifiers according to their tendency to form emulsions containing oil and water, the HLB system has been and here is applied to surfactants. Generally, the lower the HLB the greater the tendency is for the surfactant to dissolve in oil, and the higher the HLB the greater the tendency is for the surfactant to dissolve in water. A low HLB surfactant has an HLB of about 2 to 8 and is usually oil soluble or at least oil dispersible. A high HLB surfactant has an HLB of about 13 or greater and is usually water soluble or at least water dispersible. Intermediate HLB

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surfactants have intermediate tendencies. This system, which was developed by Griffin at ICI America, is now a widely accepted empirically derived standard that is used to help select alternative surfactants based on the HLB of the surfactant being used. It is also used to select groups of 5 surfactants which individually may not have the desired HLB, but collectively have a net HLB within the needed range.

The term "surfactant" as used herein does not include any hydrocolloid. Hydrocolloids are naturally occurring colloidal products, typically gums such as carboxymethyl cellulose(cmc), carageenan, pectin, agar, konjac, and 10 gelatin, which have hydrophilic moieties, but not hydrophobic moieties. Hydrocolloids are sometimes used as protective colloids or as stabilizers for emulsions and suspensions. Some have also been processed with cellulose. Hydrocolloids are not, however, considered to be surfactants within the context of this invention.

15 The term "low moisture" denotes a moisture content of no more than 30% by weight generally, and may denote a lower moisture content if so specified herein.

20 The term "mid-range moisture" denotes a moisture content within the range of greater than 30 weight percent up to but no more than 40 weight percent.

The term "high moisture" denotes a moisture content greater than 40 weight percent.

This invention is directed to a novel cellulose composite, and to methods for its preparation and use. The novel composite is the product of 25 a cellulose that has been coprocessed with surfactant. This composite is characterized in that its surface properties have been modified to customize its hydrophobic or hydrophilic characteristics, as required by its desired end use properties. Other end use properties that can be controlled include the degree of dispersability and the potential use levels, especially in low-water 30 or hydrophobic systems, and the masking of the "chalky" taste sometimes found in celluloses at high use levels. Generally, the composite has a size within the range of from about 1 to about 505 μ ; preferably it has a size within the range of from about 1 to about 55 μ ; and most preferably, it has a size within the range of from about 1 to about 25 μ .

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For the composite of this invention, a surfactant having an HLB within the range of from 1 to 40 is preferred, an HLB of 1 to 10 is more preferred; an HLB of 1 to 8 is even more preferred, and an HLB of 2 to 7 is most preferred. HLB in this context includes not only the HLB of a single surfactant, but the effective, net HLB of a combination of surfactants. The HLB of the composite is essentially the same as the HLB of the surfactant or surfactants used to make it. Examples of materials suitable in the broad aspect of this invention may be found in McCutcheon's Emulsifiers and Detergents. For the food uses, contemplated herein suitable surfactants are listed in the Food Grade section of McCutcheon's. These include but are not limited to food-grade lecithin, fractionated lecithin, monoglycerides and diglycerides; esters of monoglycerides and diglycerides with acetyl, lactyl, ethoxyl, succinyl, ricinoleic, or diacetyl tartaric groups; polyglycerol esters, propylene glycol esters, sorbitan esters, and sucrose esters. Fats, oils, proteins, other lipid materials, and blends of the above are also included to the extent they are generally recognized as safe for such use by the appropriate regulatory authority. Such recognition may vary with venue.

Some of the food grade surfactants listed in McCutcheon's are provided by their trade name, common name, manufacturer, ionic character, HLB, and use as follows: Alcolec 628G Lecithin/ coconut oil nonionic; Aldo[®] DC fractionated ester, a product of Lonza Inc., nonionic (HLB 2.0) emulsifiers used in baking, ice creams, and general use in foods; Aldo[®] MOD FG, glycerol mono/dioleate dispersible nonionic (HLB=4.0); Aldosperse[®] O-20 FG, 20% Polysorbate 80/ 80% glycerol monostearate; nonionic (HLB=5.0) a frozen desert emulsifier; Capmul GMVS-K glyceryl mono shortening, a product of Capital City Products, nonionic (HLB=3.4), shortenings for cakes and icings, margarine, whipped topping; Caprol 2G4S diglycerol tetra stearate, a product of Capital City Products, nonionic (HLB=2.5); Caprol 3GS Triglycerol monooleate, a product of Capital City Products, nonionic (HLB=6.2) a whipping agent, stabilizer, frozen desserts, fat reduction; Caprol 3GVS Triglycerol mono shortening, a product of Capital City Products nonionic (HLB=6.0) icings, shortenings; Cetodan acetylated monoglycerides, a product of Grinsted Products, nonionic (HLB= 1.5) food emulsifier, aerating agent for shortenings, toppings, cakes, edible coating, plasticizer for chewing gum base, antifoam agent, lubricant; Dimodan

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Distilled monoglycerides, a product of Grinsted Products, nonionic (HLB=3.8-5.3) food emulsifier for starch complexing, margarine, icings, shortenings, whipped toppings, vegetable, dairy systems, bakery hydrates, peanut butter, stabilizer, instant potatoes; Dur-Em®mono and diglycerides with citric acid, a product of Durkee Industrial Foods, nonionic (HLB=3.3) frozen desserts, caramels, dried potatoes; Famodan® Sorbitan esters of fatty acids, a product of Grinsted Products, nonionic (HLB=2.3-7.7) food emulsifiers for fat crystal modification and bloom retarders; Ice™No.2 blend of vegetable fat derived mono- and diglycerides with polysorbate 80, a product of Durkee Industrial Foods, nonionic (HLB=5.4) ice cream, milk, melloine, frozen desserts; Panodan Diacetyl tartaric acid esters of monoglycerides, a product of Grinsted Products, anionic (HLB=8.0) food emulsifiers for baked products and mixes to improve structure, volume, dough tolerance, shortenings, low pH emulsions, improve food suspensions, imparts freeze/thaw stability; Span 60, Sorbitan monostearate, a product of ICI Americas, nonionic (HLB=4.7) cake and cake mixes, icings, fillings, confectionery coatings and cocoa products to retain gloss, coffee whiteners, whipped toppings, flavors, antifoam, mineral oil; or wax protective coatings for fruits and vegetables, rehydration aid for dry yeast; Tween 80 POE(20) sorbitan monooleate, a product of ICI Americas, nonionic, (HLB=15) emulsifier for icings and fillings, whipped toppings, shortenings, dietary supplements, flavors, gelatin desserts, poultry defeathering scald water, antifoam, crystallizing aid for salt; Acidan citric acid ester of monoglycerides, a product of Grinsted Products, anionic,(HLB=11.0) for frying margarine and meat emulsions; Aldosperse® MS-20 FG a POE 20 glycerol monostearate, a product of Lonza Inc., nonionic (HLB=13.0) used as a bakery and general food emulsifier; Capmul EMG, an ethoxylated GMS, a product of Capital City Products Co., nonionic (HLB=13.1), used as a dough conditioner for yeast-raised baked goods; Capmul POEL polyoxyethylene (20) sorbitan monolaurate (polysorbate 20), a product of Capital City Products Co., nonionic (HLB= 16.7) used as a solubilizer for flavors; Capmul POE-S polyoxyethylene (20) sorbitan monostearate (polysorbate 60), a product of Capital City Products Co., nonionic, (HLB=14.9) used in icings, frozen desserts, whipped toppings,

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and coatings; Clearate WDF soya lecithin, a product of W.A.Cleary Corp, nonionic (HLB=8.0) used in icings, cakes, and instant cocoa.

An effective percentage of surfactant for the composite is about 1% to 50% by weight of the composite. The amount of surfactant required has been found to vary somewhat with surfactant, with 5-10 wt % being required in some situations, with a lower surfactant percentage being effective in others, and with higher surfactant percentages being better in still other situations. Below 1% of surfactant there is insufficient surfactant to satisfactorily modify the surface properties of the cellulose. As the percentage of surfactant increases, the surface of the composite increasingly tends to approach the properties of the surfactant. The optimum surfactant percentage can be determined without undue experimentation; it changes with the particle size, the surfactant used, and the nature of the system the composite is to be used in. At high surfactant percentages, the properties of the surfactant can begin to dominate or become more dominant, especially if the particle size is large. As the particle size decreases, the amount of surfactant required to provide satisfactory masking of the undesirable inherent properties of the cellulose increases. Thus, a 500 micron particle can be satisfactorily coated with 1% surfactant, whereas a 1 micron particle requires a higher percentage of surfactant to adequately cover the surface. As the particle size increases, adding the same percentage of surfactant as required for the small particle size results in the needless addition of unwanted calories found in the surfactant. Thus the preferred percentage of surfactant is within the range of 1 wt % to 50 wt %, and a more preferred percentage of surfactant is within the range of 3% to 30% of the total, an even more preferred percentage of surfactant is within the range of 3 wt % to 20 wt %; and a most preferred percentage of surfactant is within the range of 5 to 15 wt %.

Coprocessing is accomplished by any of several physical processes. These include coprocessing a mixture of a cellulose with an emulsion, a suspension, or a solution of surfactant. Suitable processes, alone or in combination, include intensive co-milling of cellulose and surfactant, either wet or dry using a bead mill, such as a Dynomill, or a mechanofusion processor; high-intensity mixing using a Henschel, a Littleford-Day or other suitable mixer; spray-drying; bulk co-drying using a fluid bed dryer or some

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other suitable dryer; fluid bed drying or agglomerating using a Glatt dryer or other suitable dryer; air drying; freeze drying using a Stork dryer or other suitable dryer; or spray chilling of emulsified, or suspended cellulose and surfactant using a Niro or other suitable spray chiller; or by coextrusion of
5 the cellulose and the surfactant, using any one of a number of commercially available extruders. When wet-processed, the liquid may be water, a non-aqueous solvent such as alcohol, or a mixture thereof. Agents that improve the compatibility of the components may also be used in any of the above processes. A preferred process includes high-intensity mixing in an
10 aqueous solution followed by either co-spray drying, or high-intensity, dry co-milling.

Coprocessing is required. The simple blending of cellulose and surfactant is not sufficient to produce the novel composites of this invention. To form such a composite, the surfactant must be free to flow onto the
15 surface of the cellulose. Such flow can occur near, at, or above the melting temperature of the surfactant or it can occur if the surfactant is in solution or if the surfactant is dispersed or emulsified. A typical process used for making the composites of this invention involves a high shear with a temperature that is sufficient to melt, to soften, or to otherwise improve the
20 flow characteristics of the surfactant. The intensity must be sufficient to force association between the hydrophilic surface of the starting cellulose, and at least the less hydrophobic part of the surfactant molecule, requiring a significant energy input, either mechanically or through a solvent system.
As a general rule, the more uniform the distribution of surfactant is
25 throughout the surfactant/cellulose system being coprocessed, the better the composite. Absent such a distribution, the surfactant will tend to aggregate particles of surfactant rather than coat individual particles. A high degree of surfactant distribution leads to a more effective use of the surfactant on the cellulose and it leads to a more uniform composite particle
30 size distribution. A more uniform composite particle size distribution provides greater quality control in the food or other end product for the composite. Thus, the finer the surfactant dispersion or the greater the degree of emulsion in the coprocessing, the better the product will be.
Coprocessing creates a physical interaction between the cellulose particle

and the surfactant; however, it is hypothesized that it generally does not tend to create covalent chemical bonding.

It is critical to the invention that the resulting composite be substantially dried before use. Generally the composite has a maximum moisture content of less than about 10 wt %, preferably less than about wt 6 %, and most preferably in the range of 2-5 wt %. The drying process fixes the surfactant onto the surface of the cellulose in a manner that tends to prevent, or at least retard, its being stripped from the surface of the cellulose by solvent.

The resulting dry composite is a free-flowing powder that may be added directly to a final-use system, such as, but not limited to, a food product. Since the composite can be added as a dry powder, the mere use of such a composite will not appreciably increase the moisture content of the food to which it is being added. Thus, the composite can be used in foods having extremely low moisture requirements, such as fat phase confections and cookie fillings.

The food in this low moisture category is generally non-aqueous; and is typically high in fat content. This is particularly true of the chocolate, the peanut butter, the nougat, the cookie filling, the confectionery filling, the icing, and the extruded snack. Some of the products in this category have less than 5 wt % moisture, other have less than 15 wt % moisture, and others may have up to 30 % water; however, in most cases, most of this water is bound water that is not available to disperse the composite.

Available water is a term which describes not the absolute amount of water contained in a product, but rather the amount of water in the product that is not chemically bound. Examples 1 through 23 particularly exemplify the low moisture foods.

The composite of this invention is a cellulose, the surface of which has been physically modified by a surfactant, with the composite assuming some of the surface properties characteristic of the surfactant. For example, on the one hand, a cellulose coprocessed with a lipophilic surfactant has a hydrophobic character, easily dispersing in oil, but floating in water without dispersing; while, on the other hand, a neat cellulose clumps, rather than disperses without dispersing in an oil, while a neat cellulose disperses in water with instantaneous settling. This novel surface

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characteristic of the coprocessed material is maintained even after it has been washed in water. This would not be expected if the composite were merely a simple mixture. It is obtained because the composite is not a simple mixture, but a cellulose having the surfactant affixed thereto.

5 Because the surface of the composite is hydrophobic, it tends not to adsorb or absorb water. Thus, the composite can be used in systems that have a low moisture level, whether or not it is a high oil content.

Using the guidelines described herein, a composite can be prepared which effectively masks the objectionable chalky taste and mouthfeel of 10 cellulose, such as microcrystalline cellulose. Thus, a coprocessed cellulose dispersed in a food, will not exhibit a chalky mouthfeel even when used in high concentrations. This is true despite the opportunity, during the sometimes extended processing of the food, for the surfactant and cellulose 15 to become separated by dissolution of the surfactant in the food, or otherwise. In contrast, a unmodified cellulose added to a similar food composition still has the chalky taste and the other properties of neat cellulose.

The primary use of the composite is as a low calorie bulking agent or as 20 a texturizer. In general, any limited moisture level food system which has limited moisture, including any food with a significant level of lipid in its formula may potentially be improved by using the composite to lower its fat and/or its caloric content, or to alter its rheology or its texture. The composite can be incorporated into a number of low moisture, nonaqueous, food systems, including: peanut butter, other high fat nut pastes; 25 confectionery spreads including cookie and wafer spreads (such as Oreo-type cookies); chocolate and other compound confectionery coatings; confectionery fillings such as nougat, caramel, truffle, fudge, etc.; confectionery icings and glazes and bakery icings and glazes; bakery creme fillings and snack spreads and fillings; and the like, with favorable results. 30 Depending on the particular end use, 1 to 35 weight percent composite can be used. One to 20 wt % is preferred, while 1 to 10 wt % is most preferred. The percentage used will be a function of either the amount of fat to be replaced in the food or the use of other bulking agents in conjunction with it. The usage level will be lower in those instances where the composite is 35 used in conjunction with other bulking agents or the composite is used as a

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bulking agent in a food that has a low fat content to begin with. The usage level will be higher where the composite is the sole bulking agent or texturizer. Similarly, a composite made with a surfactant having an appropriately selected HLB can be incorporated into mid-range or high moisture food systems within this same specified usage range.

Industrial and other non-food uses are also contemplated. Potential uses are most especially those in which moisture is limited and fat, lipid or surfactant are important components. These uses include, but are not limited to: lotions, ointments, lanolin products, cosmetic facial creams, lipstick, mascara, and dry pharmaceutical applications such as a tablet, a capsule filling, and spheronized materials for drug delivery systems. The ability to act as a finely-dispersible source of surfactant can be important in such systems. Hard waxy emulsifiers were found to be readily dispersible in oil after being coprocessed with cellulose, while solid particulate emulsifiers were very difficult to disperse in oil. Formation of dispersible surfactant ingredients by coprocessing with cellulose is another aspect of the present invention.

Other uses are suggested by the list of surfactants reported in McCutcheon's, since the composite has many of the characteristics of the surfactant it is made of. Thus, the uses accorded the emulsifier are potential uses for the composite.

Because the ratio of surfactant to cellulose in the composite is variable within broad limits, by tailoring the HLB and composition of the surfactant portion of the mixture, and by choosing the particle size of the cellulose component, compatibility with particular systems can be optimized for any contemplated end use. This tailoring can be accomplished without undue experimentation simply by choosing surfactants and particle sizes otherwise known to be effective in the particular system. Such procedures are known in the art. For example, methods of selecting surfactants, and some suggestions for certain food systems, can be found at p. 404 in the "CRC Handbook of Food Additives" (T E Furia, ed.; second edition, volume I; CRC Press, Cleveland; 1972). HLB is described by Rosen ("Surfactants and Interfacial Phenomena," Wiley, NY, 1978; p. 241-49). Flack and Krog (Lipid Tech. 2 p 11-13, 1990) describe selection of emulsifiers. A list of suitable emulsifiers, and suggestions for their use in particular foods, can be

found in industry listings, such as McCutcheon's Emulsifiers and Detergents (MC Publishing, Glen Rock, NJ).

All suitable coprocessing methods result in the formation of a surfactant layer over at least part of the cellulose particle's surface. This layer, which 5 may be either a continuous or a discontinuous layer, is sufficient to modify the general surface characteristics of the cellulose particle, and is generally lipophilic for low HLB surfactants and hydrophilic for high HLB surfactants. As a result, the composite bulking agent, consisting of the coprocessed 10 cellulose and surfactant, can be designed to be easily dispersed into systems of low moisture and/or high oil content, or they can be designed to be readily compatible with mid-range and high moisture systems. The coprocessed material is very flexible, in that the HLB of the coprocessed material can be adjusted during its manufacture to have a HLB suitable for 15 a particular use, simply by selecting the HLB or other properties of the surfactant used. The coprocessing step may also be used to modify or to tailor the composite functionality in food by controlling the particle size, the particle size distribution, the particle shape, and the ingredients used.

Compared to cellulose alone or to a cellulose and a surfactant added 20 separately to a food system, the coprocessed material improves the taste of the finished food by a reduction or an absence of the well-known dryness or astringency which is inherent in cellulosic materials under low-moisture conditions. This allows the use of cellulose as a bulking agent in materials where it is desirable but was previously not acceptable, and especially 25 allows the use of higher levels of cellulose. Thus, while prior-art cellulose can be objectionable above a few percent in low-moisture systems, the coprocessed composition of the invention can be used at levels of 10 to 20% when the appropriate surfactant is selected.

In addition, the composite can make a significant improvement in the 30 texture of the food, especially in the mouthfeel and melting properties of the food. The composite can also cause an improvement in the viscosity or processability of the finished food in manufacturing, which may be described as an improvement in the rheology of the finished food. For example in chocolate the composite can significantly reduce the viscosity of the chocolate despite the addition of higher levels of solids, thereby

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improving the coating properties of the chocolate, without affecting its taste or mouthfeel.

The inventive coprocessed material, if made from an appropriate HLB level surfactant, readily disperses in an oil continuous food such as a fat phase confection like chocolate, and in low moisture food such as a peanut butter. In contrast, the unprocessed cellulose alone, and often the surfactant itself, may be poorly dispersible in such systems. The coprocessed material further provides an improvement in the compatibility of the cellulose with certain non-aqueous food systems, such as fat phase confections.

Furthermore, the coprocessed material provides functionality for non-aqueous food systems. In chocolate, for example, the coprocessed material has an effect on viscosity, yield point, and taste.

Chocolate is a dispersion of predominantly sugar and cocoa particles in fat. Reduction of fat content has a profound effect on the rheology, and sensory attributes of chocolate. The rheology of this non-Newtonian system depends mainly on fat content, and the particle size distribution of dispersed solids, (the average particle size being within the range of 18-23 microns), emulsifier type, and quantity.

Coprocessed material, when tailored to provide hydrophobic surface characteristics is very compatible with chocolate, beneficially has minimal caloric value, and evidences a significant reduction in the chalkiness and dryness of native microcrystalline cellulose.

Although any food grade surfactant that can render the surface of the coprocessed material, the composite, hydrophobic is appropriate for chocolate, the following surfactants were found to be especially useful: polyglycerol polyricinoleate; synthetic lecithin; mono and diglycerides; distilled monoglycerides; phosphated, lactylated, succinylated, and acetylated mono, diglycerides; propylene glycol esters; sucrose esters; sorbitan monostearate, monooleate, and tristearate; and polyoxyethylene sorbitan monostearate.

Chocolate can be prepared in a number of ways. One method, is to first mix chocolate liquor, sugar, a portion of cocoa butter, and the composite of coprocessed microcrystalline cellulose/emulsifier. The dough mass is refined, preferably, immediately, to reduce the average particle size

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to a relatively uniform size. Conching was done by a batch process in a C.W. Brabender Prep Center® unit. Conching was also done in two Teledyne Readco continuous processors set in series. Conching refers to the rheological modification of chocolate which reduces the viscosity by the 5 addition of fat and by high shear mixing. For evaluation purposes, the finished chocolate was tempered and molded in solid bars. The tempering stage is a process which sets the cocoa butter crystals into their most stable form. The molded chocolate was then evaluated for rheological and sensory properties. The above described procedures relating to chocolate can be 10 varied.

The rheological properties of the chocolate, yield value and viscosity, were measured using a Rheometrics® RFS rheometer, using oscillatory dynamic mechanical measurements. Because chocolate exhibits a non-Newtonian flow they were also measured on a rotational Fann® rheometer 15 and the calculation of Casson plastic viscosity and yield value were made using Haake VT-500 software, which exhibited an excellent correlation ($R=0.99-1.0$).

20 Addition of the composite enabled a significant reduction in fat content of chocolate. Although the fat content of chocolate varies by type, taste preference, and use, a typical dark chocolate contains about 32 - 33 percent fat, although other chocolates, such as reverse phase chocolates, generally contain from 0.5 to 32 weight percent fat, and some premium chocolate confections, such as chocolate truffles, can contain as much as 50% fat.

25 Using the composite, the fat content can be significantly reduced. For example a typical dark chocolate can have its fat content reduced from 32 wt % to as low as 15% fat, and more typically within the range of 20 to 30 weight %, or 20 to 28 weight %, or 20 to 27 weight %. This is a reduction of 40 % fat content, 12% less fat than the original. For chocolates 30 generally, a fat reduction of 0-40% is achievable, a fat reduction of from 15 to 40% is preferred, and a fat reduction of from 25 to 40 % is most preferred.

In addition to reducing the fat calories of the chocolate, the sugar 35 calories of the chocolate can be reduced. Typically, chocolates contain various monosaccharides or disaccharides. These can be replaced by

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alternate sweeteners. These include sugar substitutes, such as aspartame, acesulfame K and the like; sugar alcohols, such as maltitol, lactitol, mannitol, and xylitol, and the like; and other polysaccharides such as polydextrose, polyfructose, and the like. These sugar substitutes, also called alternate sweeteners, typically are not metabolized by the body, or are less efficiently metabolized than are the mono and disaccharides normally used in chocolate.

The typical sugar content of chocolate is variable, but usually lies within the range of from 40 to 50%. However, in sugar reduced chocolates, the sugar content may be within the range of from 0.5 to 50 weight % sugar; preferably within the range of from 0.5 to 30 weight % sugar and most preferably within the range of 0.5 to 20 weight percent sugar. Some or all of this sugar can be replaced using these alternate sweeteners. The sugar calorie content of chocolate, can thus be reduced. Generally the reduction can be from 0 to 100%; preferably, from 50 to 95%, and most preferably from 80 to 95%.

Using the composite and the alternate sweeteners provide a chocolate confection having significantly fewer calories than traditional chocolate. Using this combination, one can prepare a chocolate confection having a total calorie content per 100 grams of from 180 to 415, preferably from 180 to 280, and most preferably from 180 to 220.

These chocolate confections can contain 20 to 30 weight percent fat, 3 to 30 weight percent of a cellulose/surfactant composite, preferably a microcrystalline cellulose/surfactant composite, and 0.5 to 50% sweetener, preferably an alternate sweetener. Preferably the chocolate confection contains from 20 to 28% fat, 10 to 30% composite, and the sugar is a sugar substitute. More preferably, the chocolate confection contains 24 to 27% fat, 10 to 30% composite, and 0.5 to 40% alternate sweetener.

The composite can also be used to provide a reverse phase chocolate or a chocolate crumb.

The following examples are intended as a further illustration of the invention, but not as a limitation on the scope of the invention. All parts and percentages in the examples, and throughout this specification and claims, are by weight, and all temperatures are in degrees centigrade, unless otherwise indicated.

- 15 -

Example 1

Preparation of a Coprocessed Cellulose Surfactant Ingredient

5 Avicel® FD 006 microcrystalline cellulose, a product of FMC Corporation, has an average particle size within the range of about 5 to 10 microns. Of this material, 1846.15 g. was dispersed in 11,287.15 g. of deionized water that had been heated to 82.2°-93.3°C (180-200°F). The dispersion was processed using a Gifford-Woods Colloid Mill set at 70%
10 speed (approximately 4900 rpm) and at 40 mil clearance. Then 200 g. of a surface active agent, a Polycon S60K sorbitan monostearate, a product of Witco Corporation having an HLB about 4.7 was first heated to 76.7°C (170°F), then added to the Avicel dispersion in the colloid mill. The mixture of dispersed Avicel and emulsifier was maintained at a temperature of
15 71.1°C (160°F) to keep the emulsifier above its melting point and in a liquid state. The mixture was then homogenized at 60.0°-65.6°C (140-150°F) using a Manton-Gaulin homogenizer set at 17,237.5 kPa (2500 pounds per square inch).(13,790 kPa (2000 psi), first stage, 3447.5 kPa (500 psi) second stage). The homogenized mixture at 60.0°C (140°F) was then
20 pumped by a Moyno pump from a holding tank to the spray head of a two-fluid nozzle atomizer that was located in a Stork Bowen 3 foot diameter spray dryer. The material was atomized at 620.55 kPa (90 psi) air pressure using a 2.54 mm (0.1 inch) nozzle, and then dried at 175°C inlet temperature and 90°C outlet temperature. The final material was dried to 2-
25 4% moisture and was screened through a U.S. 60 mesh screen to produce a fine free flowing powder. This material can be used for a confectionery filling, such as for a caramel, a peanut butter filling or a spread.

Example 2

30 Coprocessed Ingredient from a Cellulose Floc

Eight hundred fifty grams of Solka Floc® 200 FCC cellulose powder, a product of Fiber Sales and Development Corporation, a subsidiary of Protein Technologies, having a mean particle size 35 μ was slurried into
35 9000 grams of water heated to a temperature of 93.3°C (200°F). One

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hundred-fifty grams of sorbitan monostearate, a lipophilic surfactant having a HLB of about 4.7 and a melting point of 54.4°C (130°F), was melted and gradually added to the hot cellulosic slurry circulating through a Gifford Wood colloid mill (10 mil clearance) to produce mechanical emulsification of 5 the surfactant in the continuous water phase. The resulting emulsion was passed through a two stage Manton Gaulin homogenizer first at 17,237 kPa (2500 psi) then at 3447.5 kPa (500 psi), and then spray dried to form a powder.

The spray drying was performed as follows: The homogenized slurry 10 was atomized by feeding it at 620.55 kPa (90 psi) atomizing air pressure to a 91.44 cm (3 foot) Bowen spray dryer having a nozzle with a 2.54 mm (0.1 inch) atomization opening . The slurry was fed to the dryer by means of a variable feed Moyno pump at a rate to provide the desired outlet temperature. The operating inlet and outlet air temperatures of the spray 15 dryer were about 150°C and 80°C, respectively. A free-flowing powder was obtained.

Essentially normal cellulose particles were observed when the free flowing spray dried powder was placed on a microslide and examined 20 microscopically. Heat applied directly to the microslide with a hair dryer liquefied the particle surface layer and produced a puddling of material at the bottom of the cellulose particles when the melt point of the lipid layer was exceeded. The spray dried powder containing 85% cellulose and 15% sorbitan monostearate was reconstituted in water at 10% solids by vigorous 25 hand-stirring. The coprocessed powder tended to float and to collect on the surface of the water. As a control, uncoated (not coprocessed) cellulose powder was added to water; it readily dispersed, swelled and remained suspended for several minutes.

30

Example 3
Dry Coprocessing

Mechano Fusion is a technology for coprocessing two or more materials to obtain a modified material in which one of the materials is 35 deposited onto the surface of another. The technology is based on using

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high intensity mixing and a compaction device. Ninety grams of Avicel® FD006 microcrystalline cellulose, a product of FMC Corporation, and 10 grams of Polycon® 60 sorbitan monostearate, a product of Witco Corp. having an HLB of about 4.7, were dry blended and placed in the Mechano 5 Fusion® AM-15 coprocessor, a product of Hosokawa Micron International Inc. Shear was generated by the high intensity mixing and compaction and was monitored by an increase in the temperature of the powder. The powder was mixed, compacted, and scraped off of the walls of the chamber and the process was repeated. During the process, the temperature 10 increased because of the intense shear. For this particular sample the process was stopped after the temperature reached 71.1°C (160°F) for 5 minutes, which allowed the surfactant to melt.

The resulting dry, coprocessed powder dispersed easily in oil, significantly faster than microcrystalline cellulose alone. When added to 15 water, the coprocessed powder floated on the surface; it would wet and settle to the bottom of the flask only after prolonged stirring; however, a non-coprocessed cellulose, such as the Avicel® FD006 microcrystalline cellulose, settled to the bottom immediately. This water washed composite, after prolonged high shear stirring in water and after the water was 20 decanted, was air dried to a constant weight. This dried powder also would not wet easily when added to water indicating that the surface of the coprocessed microcrystalline cellulose was still modified compared to untreated microcrystalline cellulose.

25

Example 4

Coprocessing in a Non-Aqueous Processing Fluid

An alternative method for coating MCC with a surfactant is by dissolving the surfactant in a solvent, adding the dissolved surfactant to MCC, mixing 30 the MCC with the surfactant and evaporating the solvent. Thus, 10 g of Polycon 60® sorbitan monostearate, a product of Witco Corp having an HLB of about 4.7, was dissolved in 100 g of 2-propanol at 60°C. Then 90 g of fine grind MCC was added to the solution and stirred with a laboratory mixer for 5 min. The resulting paste was spread in a 6 inch cake baking 35 dish and dried at 50°C. The resulting powder was evaluated in a manner

(1) Ternary blend example
(2) fine grind the MCC

described in Example 3. The powder performed very similarly to the powder in Example 3.

Examples 5 (a-o)

Use in Chocolate

5

Coprocessed compositions and control compositions using cellulose were used in the following procedure for making chocolate. The amounts and proportions of the various non-cellulose ingredients are variable in the art. In the following example of a basic chocolate recipe, cellulose or a coprocessed cellulose/surfactant ingredient is assumed to be added at 10% of the weight of the entire composition. Addition of cellulose-based ingredients at other levels (5%, 13%) was also done; the approximate use levels can be found simply by altering the weight of cellulose added.

15

1. Mix chocolate liquor (9%), sugar (45%), milk powder (for milk chocolate) (14%), a portion of cocoa butter (about 15%, of a final total of about 22%), and coprocessed material or control cellulose (at 10% when present), in a Sigma/Z mixer for 10 to 20 minutes with a jacket temperature set at 54.4°C (130 °F). (Dry ingredients are preblended prior to mixing.) Adjust the consistency of the final dough mass with either added cocoa butter or a longer mixing time.

20

2. Refine the dough mass immediately on a Day 5" x 12", 3- roll refiner. Adjust the feeder rolls to deliver consistent mass to refining rolls; adjust the refining rolls to reduce the particle size to a uniform minimum of 20 microns. For milk chocolate, cooling water at 14.4°C (58°F) may be needed to maintain a finished refined mix temperature of under 60.0°C (140°F); dark chocolate can be processed at a higher temperature.

30

3.& 4. Conching 1 and 2: Conch in either of two continuous processors set in series for a continuous process; or conch for 8-12 hour in a Sigma mixer for a batch process. First, set to dry conch; second set to wet conch: add cocoa butter (the rest of the 7% saved from the first step) and lecithin (0.5%) if required to reduce process viscosity in the finish conch. Product

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temperature during the process should not exceed 87.8°C (190°F) for dark chocolate, or 65.6°C (150°F) for milk chocolate.

- 5 5. Temper the finished chocolate as follows: Pour out about 2/3 of the warm finished chocolate onto a marble table. Spread the chocolate into a thin layer about 1/4" deep onto the table. Work the chocolate by scraping and respreading until the mass is cooled to 30.0°C (86°F) for dark chocolate and 27.8°C (82°F) for milk chocolate. This will form stable seed crystals of cocoa butter. Reintroduce this cooled mass back into the container and mix vigorously with the rest of the chocolate. The final temperature should reach 33.3°C (92°F) for dark chocolate and 30.0° (86°F) for milk chocolate in order for the entire mass to now crystallize into the most stable crystal form for cocoa butter.
- 15 6. Pour the tempered chocolate into moulds and tap to even the mass and remove excess air. Cool quickly with good ventilation at 18.3°C (65°F). Cooling will take about 40 minutes. Gently twist and remove the cooled chocolate from the moulds once the chocolate has fully contracted; then store the chocolate at 21.1°C (70°F) to develop optimum gloss and maintain proper temper.

The finished chocolate product produced with a coprocessed cellulose/surfactant material showed several improvements over a chocolate product with cellulose alone. In some variables, it was also an improvement over conventional chocolate. Among these improvements is a lower process viscosity and yield value, which can be dramatic at 10% and above of the coprocessed material, which is superior to control material containing cellulose alone. These improvements make it much easier to coat confectionery to a defined thickness and uniformity with chocolate containing the inventive composition. In addition, with the coprocessed material, in contrast to cellulose, a higher level of non-nutritive material can be incorporated without adverse taste effects, which leads to a greater reduction of fat and total calories for the finished food.

Also, the coprocessed material demonstrated a great stability in use. In the extended processing required to make chocolate, there was ample

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opportunity for the surfactant to become detached from the surface of the cellulose. It is evident from the results of the testing shown below that at least an effective layer of surfactant remained on the cellulose, so that it did not become aggregated and did not revert to the taste of unmodified cellulose.

5 cellulose.

Sensory Evaluation of Milk Chocolates

Samples of milk chocolate made by the above method with
10 coprocessed compositions and with cellulose were evaluated qualitatively
for taste and texture. Coprocessing was by the method of Example 1, using
the Avicel® FD006 microcrystalline cellulose of Example 1, or a related
material Avicel® FD008 microcrystalline cellulose, having a significantly
larger median particle size (8 μ) than FD006 (about 6 μ). Particle sizes
15 were measured on a Horiba 7000 particle analyzer. The results are
reported in Table 1.

In Table 1, "ratio" denotes the weight percent surfactant in the
coprocessed composition, and "% in Choc" denotes the amount of cellulose
or coprocessed material added as in step 1. Evaluation was by an expert
20 informal sensory evaluation panel.

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Table 1.Effect of additives in chocolate.

Ex.

	No.	Cellulose	Surfactant	Ratio	% in	Choc.	Evaluation
5	6a	(milk chocolate control, no additives)			none		(standard of reference)
	6b FD006	(none)			10%		less taste, slow melt, slightly chalky
10	6c FD006	(none)			5%		difference less, but still detectable
	6d FD006	sorbitan monostearate		20%	6%		no chalkiness, like standard
	6e FD006	sorbitan monostearate		20%	10%		no chalkiness; a little greasy
15	6f FD006	sorbitan monostearate		10%	10%		standard - no detectable difference
	6g FD006	sorbitan monostearate		6%	6%		slow melting, palate adhesion
	6h FD006	sorbitan monostearate		6%	4%		almost standard
20	6i FD006	soy lecithin		20%	6%		oxidized lecithin taste; not chalky
	6j FD006	sodium stearoyl lactylate		20%	6%		detergent off-taste, not chalky
	6k FD006	glycerine		10%	6%		off flavor, waxy texture
25	6l FD006	polydextrose		20%	6%		poor texture, off flavor
	6m FD006	maltodextrin		10%	6%		very chalky, gritty
	6n FD100	(none)			4%		very chalky, dry

30

These tests show that:

1. With a preferred surfactant for a particular food, in this case sorbitan monostearate for milk chocolate, very high levels (at least 10%) of a coprocessed cellulose/surfactant ingredient can be incorporated with no effect on texture or taste.

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2. With other surfactants differing in HLB, poor taste can result, even if chalkiness is masked. The most successful surfactant employed in this Example 6, sorbitan monostearate, had a HLB of about 4.7. Emulsilac SK, sodium stearoyl lactate, a Witco product that has an HLB of 20 was used, and it appeared to work better as moisture levels increase. Lecithin with an HLB of about 5 and mono, di-glycerides with an HLB of about 2.8 gave taste notes intrinsic to their compositions. Surfactant intrinsic taste is also a variable commonly considered in food manufacture.

5 3. Coprocessing with materials not of the invention, as in samples 6k, 6l
10 and 6m, failed to mask the chalky taste of the cellulose and/or imparted a
 bad texture, even at low use levels.

Example 6

Preparation of Samples for Quantitative Evaluation of Sensory Effects

15 A standard simple test system was used and prepared by the following recipe. In a 600 ml. beaker, 250 grams of a hard fat, cocoa butter, was melted by heating on a heating mantle. With constant mixing, using a CafraMixer set at 500-1000 rpm speed, a quantity of 12.5 grams, 25.0
20 grams, or 50 grams, of the coprocessed ingredient was added and dispersed in the melted fat by stirring. The fat was at a temperature of 48.8°C-60.0°C (120°F-140°F), which is above the melting point of cocoa butter.

25 The melted fat containing the dispersed material was poured into forms of about 1" square (small polyethylene weighting boats). The samples were then set in a freezer for 30 minutes to 1 hour to 'set' the dispersed material in the fat. These samples with varying levels of ingredients were tasted by a specific sensory protocol to characterize and quantify differences.

30

Example 7

Quantitative Sensory Results.

35 A formal sensory protocol was used to quantify taste and texture differences, using standard sensory panel testing methods. This sensory protocol identified three groups of attributes affecting the mouthfeel, which

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were important in understanding the effect of incorporating cellulosic materials in a non-aqueous/low moisture system. These attribute groups were astringency-related, described as drying, roughing, puckering; particle-related, described by overall amount of particles, size, chalkiness; 5 and melt-related, described by melt rate, melt consistency (homogeneity), and by residual mouth-coating.

The results of the testing showed improved mouth feel characteristics in all three attribute groups. Cellulose alone had a considerable gritty or chalky feel depending on the particle size. The coprocessed cellulose/surfactant 10 material significantly reduced those effects. There was also an improvement (decrease) of the "drying, roughing, puckering" effect especially at the higher use levels of the coprocessed material in the cocoa butter medium. Finally, there was an improvement in melt consistency by using a coprocessed material. All these improvements together gave a 15 much more palatable texture.

The averaged results obtained by nine taste testers on the variable "chalky" were obtained, using materials prepared as in Example 6. The coprocessed ingredients were prepared as in Example 1, using Avicel® FD006 microcrystalline cellulose ("cellulose"), a product of FMC Corporation 20 coprocessed with 10% of sorbitan monostearate (sample "S"). Results are shown in Table 2. The numbers obtained are the perceived "chalkiness"; higher numbers indicate a more chalky mouthfeel. Note that the perceived values of the control (no additive) material vary between tests over a range of 0.7 units.

25

Table 2
Relative Chalkiness

	<u>Additive type:</u>	<u>Cellulose only</u>	<u>Coprocessed "S"</u>
30	<u>additive use level:</u>		
	no-additive control	2.4	1.7
	5%	2.9	2.1
	10%	4.8	2.7
35	20%	7.2	2.7

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At 5% addition, the unprocessed cellulose was not significantly chalkier than the base cocoa butter; however, at 10% and 20% addition, the cellulose-only samples were very significantly chalky. The coprocessed material was similar to the no-cellulose control at a low level of addition; at higher levels, however, the coprocessed material increased in chalkiness only slowly with use level, whereas the cellulose only control increased rapidly in chalkiness with increasing use level; and even at a use level of 20% the coprocessed sample was not significantly higher than the control level, while the cellulose only sample was significantly chalkier.

Example 8
Dispersion of Surfactant

15 A coprocessed material was prepared as in Example 1 with the exception that a small amount of the oil-soluble dye Oil Red O was used with the surfactant. As a control, the surfactant, sorbitan monostearate, was melted, mixed with an equivalent amount of dye, cooled, and cut up into pieces. When added to a room temperature liquid soybean oil, the 20 coprocessed cellulose-surfactant ingredient easily dispersed, producing a smooth viscous suspension, and the dye was extracted from the particles into the oil. When pieces of dyed sorbitan monostearate were dispersed into room temperature oil, the pieces immediately settled to the bottom of the container without dissolution of the surfactant, and the dye was not 25 significantly extracted from the particles. When the solution was heated, the particles dissolved and the dye was extracted. This demonstrates that the coprocessed material of the invention can also act as a method of dispersing surfactants into a food or other system.

30 Example 9
Fat Phase Truffle

The following is one method for preparing a fat phase truffle. Dark chocolate is heated in a microwave set at full power for 5 minutes to heat it 35 to a temperature of 54°C, then placed in a bowl and cooled to 32°C. Nut

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paste, melted vegetable fat, and flavoring are then added, and the mixture is mixed using a Hobart paddle mixer, first at about speed 1. The mixer speed is then increased to speed 2, with either the composite or the microcrystalline cellulose being added with mixing.

5 The admixture is poured into and spread in a shallow pan; then it is cooled to 30°C or lower, until it is sufficiently firm to scoop with a cookie dropper or a melon scooper; after which it is rolled and dusted with a cocoa powder, using dutched cocoa powder, which contains 10-12% fat.

10 The truffle containing the composite tastes the same as the truffle that contains no cellulose ingredient, and has a better taste and texture than cellulose alone; in this example the use of either the neat cellulose or the composite results in a product having an approximately 10% reduction in fat in the formula, as compared to the control.

Table 3
Fat Phase Truffle

Ingredients	Control %/ grams	Neat Cellulose %/ grams	Composite %/ grams
Dark Chocolate	62.18% 1200 grams	56.99% 1100 grams	56.99% 1100 grams
Hazelnut Paste	31.09% 600 grams	31.09% 600 grams	31.09% 600 grams
Hydrogenated Coconut Oil	6.22 % 120 grams	1.45% 28 grams	1.45% 28 grams
Rum Flavor	0.52% 10 grams	0.52% 10 grams	0.52% 10 grams
Composite	0% 0.00 grams	0% 0.00 grams	9.95% 192 grams
Neat Cellulose	0% 0.00 grams	9.95% 192 grams	0% 0.00 grams
Total	100.00% 1930 grams	100.00% 1930 grams	100.00% 1930 grams

5 Preferred ingredients:

Dark chocolate couverture

Pure hazelnut paste

Partially hydrogenated palm kernel/coconut, Pureco 90/92, a product of
Karlshamns Co.

10 Natural and artificial Jamaican rum extract FA 34, a product of Virginia
Dare.

Avicel® microcrystalline cellulose, Avicel is a trademark of the FMC
Corporation.

Composite: 90% Avicel® microcrystalline cellulose/ 10% sorbitan
15 monostearate.

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Example 10
Chocolate Chip

5 A typical chocolate chip is about 30% fat. The chocolate chip is a dark chocolate that has been prepared as in Example 5, with the exception that it is deposited as a drop.

The sensory result is good for each of the respective chocolates.

10 Preparation of a Coprocessed Cellulose/Surfactant Ingredient

Avicel® FD 006 microcrystalline cellulose, a product of FMC Corporation, has an average particle size within the range of 5 to 10 microns. In a Gifford Woods Colloid Mill heated to about 93.3°C (200°F) by 15 boiling water is placed about 11.3 Kg of deionized water. The mill was operated at a rheostat setting of 70% (approximately 5000 RPM) and a 40.5 mil clearance to disperse 1846.15 grams of FD 006 in the water. To aid mixing a Lightnin mixer was also inserted into the mill hopper. Milling continued for about 10 to 15 minutes to fully disperse the FD 006 cellulose. 20 During the dispersion, 200 g of Polysorbate 60 (Tween® 60) was melted to about 60°C (140°F). Upon completion of the milling operation, the molten polysorbate was added to the dispersed FD 006 in the colloid mill hopper at a reduced rheostat setting of 50% to minimize foaming, during which the temperature was maintained at about 71.1°C (160°F) to keep the 25 temperature above the melting point of the surfactant. The mixture was then homogenized at about 60°C (140°F) using a Manton-Gaulin homogenizer set at 20,685 kPa (3000 pounds per square inch) (17,237.5 kPa (2500 psi) first stage, 3,447.5 kPa (500 psi) second stage). The homogenized mixture was then pumped at 60°C (140°F) by a Moyno pump 30 at setting #2 from a holding tank to the spray head of a two-fluid nozzle atomizer located in a Stork Bowen 3 foot diameter spray dryer. The material was atomized at 620.55 kPa (90 psi) air pressure using a 2.54 mm (0.1 inch) nozzle and then dried at 150°C inlet temperature and 80°C outlet temperature. The product was dried to about 2-4% moisture and is 35 screened through a U.S. 60 mesh screen to produce a fine, free flowing

powder. This procedure was used for all examples of coprocessed microcrystalline cellulose reported herein except that shown in Example 2.

Example 12

5 Preparation of Coprocessed Cellulose/Sucrose Ester Surfactant Ingredient

Avicel® FD 006 was dispersed as in Example 1. A monostearate ester of sucrose (S570) from Mitsubishi-Kasei Food. Co. was melted at 71.1°C (160°F) and small quantities of hot (82.2-93.3°C (180-200°F)) deionized water sufficient to prepare a slurry added. The amount of water was equal in volume to the surfactant, and the slurry resembled a semi-solid carrageenan or pectin gel. This slurry was added very slowly to the dispersion of microcrystalline cellulose in deionized water which was maintained at 82.2-93.3°C (180-200°F) during the addition. The remainder of the processing was the same as described in Example 11.

Example 13 (a-o)

Batch Preparation of Dark Chocolate Having a Fat Content of ~27% Using Coprocessed Microcrystalline Cellulose/Surfactant Ingredients

20 In a Brabender Prep Center Sigma® mixer heated to 56°C (132.8°F) was placed 208.70 grams of chocolate liquor (West African, medium roast (#1 natural process) from Wilbur Chocolate Co.) and 215.00 grams of premilled sugar (approximately 4X from Wilbur Chocolate Co.). This combination was mixed for 15 minutes at 75 rpm after which 50.60 grams of coprocessed microcrystalline cellulose/surfactant was added and mixing continued until a uniform mixture was obtained. In some cases it was necessary to add a small portion of cocoa butter and/or lecithin to improve the mixing. This mixture was then milled twice on a Day 5" x 12", 3-roll refiner with the rolls adjusted to deliver a mass having a uniform particle size of 20 microns. The mixture was then returned to the Brabender Sigma Mixer heated to 73.3°C (163.9°F) and operating at 25 rpm. A small amount of cocoa butter was added at this time to facilitate mixing. The dry conch period began when small dough balls appeared in the mixture and then continued for two hours. Wet conch began at the conclusion of this two

hour period in the same mixer. The speed was set at 45-50 rpm, and a predispersion of 2.50 grams of lecithin in 23.30 grams of cocoa butter was added to the mixture. The amounts of cocoa butter and lecithin were reduced by any amount that had been introduced into the mixture during
5 mixing or the dry conch step. After mixing was completed, the speed of the mixer was maintained at approximately 20-45 rpm at which time the wet conch began and then continued for a period of two hours. At the conclusion of the conching the mass was removed from the Brabender Sigma Mixer. When the chocolate reached a temperature of 48.9°C
10 (120°F), two-thirds of the chocolate was poured onto a marble table for tempering. During this step a thin layer (approximately 6-7 mm thick) of chocolate was worked back and forth to crystallize the cocoa butter. When the tempered chocolate cooled to 28.9-30°C (about 84-86°F), it was mixed vigorously with the remainder of the chocolate mixture that had not been
15 tempered. The final temperature of the entire mixture was 32.3-33.3°C (about 90-92°F). At this point the chocolate was poured into molds which were tapped to remove air bubbles. The molded chocolate was cooled quickly to 18.3°C (65°F) and then stored at 21.1°C (70°F) and 50% relative humidity until it was evaluated. The following coprocessed microcrystalline
20 cellulose/surfactant materials, all containing 90% FD 006 microcrystalline cellulose and 10% of the identified surfactant, were formulated using the above procedure. They were evaluated for viscosity yield value using a rotational Fann® rheometer, and calculations of the values according to the Casson model were made using Haake VT-500 software. The surfactant
25 coprocessed with FD 006 microcrystalline cellulose, sensory evaluations and the calculated values of the viscosity and yield value are shown for each formulation below:

3a Triodan® R-90, polyglycerol polyricinoleate from Grindsted Products
30 Inc. Viscosity = 5.57 Pa·s; yield value = 16.57 Pa.

3b Triodan® 55, Grindsted Products Inc. Viscosity = 2.57 Pa·s; yield
value = 163.09 Pa.

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- 3c Span® 65, sorbitan tristearate from ICI Surfactants. Viscosity = 2.92 Pa·s; yield value = 114.68 Pa.
- 3d Polycon® S-80, sorbitan monooleate from Witco, Corp.. Viscosity = 3.05 Pa·s; yield value = 109.75 Pa.
- 3e Synthetic lecithin YN from Palsgaard Industrie A/S. Viscosity = 2.20 Pa·s; yield value = 84.17 Pa.
- 10 3f Emphos™ D7030, phosphated mono, diglycerides from Witco, Corp. Viscosity = 2.05 Pa·s; yield value = 85.46 Pa
- 3g Panodan®, diacetyl tartaric esters of monoglycerides from Grindsted Products Inc. Viscosity = 2.57 Pa·s; yield value = 150.10 Pa.
- 15 3h S570, sucrose monostearate from Mitsubishi-Kasei Food. Co. Viscosity = 2.01 Pa·s; yield value = 14.69 Pa.
- 3i Myverol® P-06, distilled propylene glycol monoesters from Eastman Chemical Co. Viscosity = 3.39 Pa·s; yield value = 109.50 Pa.
- 20 3j Atmuf® 2622K, lactylated monoglycerides from Witco Co. Viscosity = 4.32 Pa·s; yield value = 119.60 Pa.
- 25 3k Atmuf® 84K, mono, diglycerides from Witco Corp. Viscosity = 2.17 Pa·s; yield value = 231.70 Pa.
- 3l Dimuf® DDMK, distilled monoglycerides from Witco Corp. Viscosity = 2.96 Pa·s; yield value = 275.60 Pa.
- 30 3m Myverol® SMG, succinylated mono, diglycerides from Eastman Chemical Co. Viscosity = 0.99 Pa·s; yield value = 291.00 Pa.
- 3n Myvacet® 9-45, distilled acetylated monoglycerides from Eastman Chemical Co. Viscosity = 3.15 Pa·s; yield value = 251.00 Pa.

3o Tween® 60, sorbitan monostearate from Surfactants. Viscosity and yield value are too high to measure.

5 Sensory Evaluation of Dark Chocolates

Samples of the dark chocolate made by the above method with coprocessed compositions prepared by the methods of Examples 11 and 12 are evaluated by an experienced individual for taste and texture. The 10 control being used for comparison has 32% fat and contains no microcrystalline cellulose or microcrystalline cellulose coprocessed with a surfactant. The results of this evaluation are shown in Table 4, "#" denoting the corresponding example:

15

Table 4
Effect of additives in dark chocolate

Ex.

No.	Surfactant	Taste and Texture Description
3a	Triodan® R-90	Good melt, slightly better than control; flavor almost the same as the control
3b	Triodan® R-55	Melt is very good, slightly "cleggy"; satisfactory flavor
3c	Span® 55	Melt is very good, slightly "cleggy"; satisfactory flavor
3d	Polycon® S-80	Melt is good, very slightly "cleggy"; flavor slightly worse than the control
3e	YN lecithin	Melt is good, very slightly "cleggy"; good flavor
3f	Emphos™ D7030	Melt equal to the control; very good flavor

3g	Panodan® 150K	Melt is "cleggy", sticking to mouth; satisfactory flavor
3h	S570	Excellent melt; good snap; excellent flavor
3i	Myverol® P-06	Melt is good, very slightly "cleggy"; satisfactory flavor
3j	Atmuf® 2622K	Melt is good, very slightly "cleggy"; satisfactory flavor
3k	Atmuf® 84K	Melt is very good, slightly "cleggy"; satisfactory flavor, but slightly chalky
3l	Dimul® DDMK	Melt is fairly good; flavor is satisfactory
3m	Myverol® SMG	Melt is fair, slightly "cleggy"; satisfactory flavor, but with a slightly sharp taste
3n	Myvacet® 9-45	Melt is fair, slightly "cleggy"; satisfactory flavor, but with a slightly off taste
3o	Tween® 60	Melt is "cleggy"; flavor is slightly off and tastes chalky

The descriptive term "cleggy" denotes a viscous, cohesive mass which adheres to the palate. Creamy peanut butter possesses this property."

Example 14 (a-d)

5 Batch Preparation of Dark Chocolate Having a Fat Content of ~27%
Comparing Various Methods of Reducing the Fat Content

By the method of Example 12 four formulations of reduced fat (~27%) chocolate were prepared and evaluated for viscosity and yield value. Table 5 shows the formulations and the calculated values.

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Table 5

Formulation	14a	14b	14c	14d
<u>Ingredients</u>	<u>grams</u>	<u>grams</u>	<u>grams</u>	<u>grams</u>
Chocolate liquor	224.90	208.70	208.70	208.70
Sugar	252.60	215.00	215.00	215.00
Cocoa butter	14.95	28.25	23.20	23.20
YN ^a	2.53			2.53
Admul® WOL ^b	2.53			2.53
FD 006 cellulose		45.55		45.54
FD 006/YN ^c			25.30	
FD 006/Admul WOL ^d			25.30	
Lecithin	2.50	2.50	2.50	2.50
Viscosity	3.29 Pa	3.83 Pa	5.46 Pa	3.45 Pa
Yield value	13.4 Pa·s	108.70 Pa·s	27.14 Pa·s	9.11 Pa·s

a Synthetic lecithin from Palsgaard Industrie A/S.

5 b Polyglycerol polyricinoleate from Quest
 c Coprocessed 90% FD 006 with 10% YN synthetic lecithin
 d Coprocessed 90% FD 006 with 10% Admul WOL

Example 15 (a-e)10 Continuous Preparation of Dark Chocolate Full and Reduced Fat Formulations

In a 6 liter Sigma/Z mixer heated to 54.4°C (130°F) were mixed at 45 rpm the chocolate liquor, sugar, microcrystalline cellulose (if included in the formulation), and a portion of the cocoa butter. Mixing required about 5-8 minutes. The dough mix was refined on a Day 5" x 12", 3-roll refiner with the rolls adjusted to reduce the particle size to a uniform minimum size of 20 microns. Conching was carried out in two Teledyne-Readco Continuous Processors placed in series. Both units have 2" flat elements set at 90° to produce maximum shear. The running speed of these units is 200 rpm with a weir/slide plate set at an opening of 6.35 mm (0.25 inch). The first unit

was set up for dry conching, and the second unit for wet conching. Both units were heated at 71.1°C (160°F). Residence time in each unit was approximately 5-8 minutes, and the temperature during this time was not allowed to exceed 87.8°C (190°F). The tempering and molding procedures described in Example 13 were followed. The specific formulations follow in Table 6.

Formulation		15a	15b	15c	15d	15e
Ingredients		kilograms	kilograms	kilograms	kilograms	kilograms
Chocolate liquor		2.413	2.304	2.304	2.191	2.191
Sugar, 4X		2.713	2.486	2.486	2.259	2.259
Cocoa butter		0.463	0.517	0.417	0.572	0.476
FD 006		0.000	0.281	0.281	0.558	0.558
Lecithin		0.028	0.028	0.028	0.028	0.028
Percent fat		32.0	30.2	30.0	30.2	29.5
Viscosity		1.52 Pa·s	1.05 Pa·s	1.55 Pa·s	1.49 Pa·s	2.25 Pa·s
Yield value		24.81 Pa	14.83 Pa	22.03 Pa	13.29 Pa	20.58 Pa

10

Example 16 (a-e)
Continuous Preparation of Milk Chocolate Full and Reduced Fat
Formulations

In a 6 liter Sigma/Z mixer heated to 54.4°C (130°F) are mixed at 45 rpm the chocolate liquor, milk powder, sugar, microcrystalline cellulose (if included in the formulation), and a portion of the cocoa butter. The dry ingredients are premixed before being placed in the Sigma/Z mixer. Mixing requires about 5-20 minutes. The dough mix is refined on a Day 5" x 12", 3-roll refiner with the rolls adjusted to reduce the particle size to a uniform minimum size of 20 microns. The temperature during mixing and refining is maintained below 60°C (140°F) to prevent release of the water of crystallization from the lactose in the milk powder. Conching is carried out in two Teledyne-Readco Continuous Processors placed in series. Both units have 2" flat elements set at 90° to produce maximum shear. The

running speed of the first unit is 271 rpm and the second unit is operated at 311 rpm with a weir/slide plate set at an opening of 7.94 mm (0.3125 inch). The first unit is set up for dry conching, and the second unit for wet conching. Both units are operated at 37.8-48.9°C (100-120°F). Residence time in each unit is approximately 5-8 minutes, and the product temperature during this time is not allowed to exceed 65.6°C (150°F). The tempering and molding procedures described in Example 13 are followed except that the temperature at which tempering is complete is 27.8°C (82°F), and the final temperature after mixing the tempered chocolate with the one-third that is not tempered is 30°C (86°F). The specific formulations follow in Table 7.

Table 7.

Formulation	16a	16b	16c	16d	16e
Ingredients	kilograms	kilograms	kilograms	kilograms	kilograms
Chocolate liquor	0.599	0.544	0.544	0.490	0.490
Sugar, 4X	2.640	2.558	2.558	2.449	2.449
Milk Powder	1.034	0.871	0.871	0.735	0.735
Cocoa butter	1.143	1.170	0.925	1.197	0.767
FD 006	0.000	0.272	0.281	0.544	0.544
Lecithin	0.027	0.027	0.027	0.027	0.027
Percent fat	30.4	30.0	28.1	30.0	28.3
Viscosity	2.28 Pa·s	-	3.47 Pa·s	-	2.69 Pa·s
Yield value	22.20 Pa	-	44.84 Pa	-	39.36 Pa

15

Example 17 (a-f)

Batch Preparation of Dark Chocolate Having a Fat Content of ~27% and Reduced Calorie Content by Replacing Sugar with Lower Calorie Ingredients

20

The procedure of Example 13 is followed in the batch preparation of the dark chocolate formulations having reduced calorie content by replacing sugar with lower calorie sweeteners. The only exception is that when

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Aspartame®, a product of G. D. Searle, is used it is added one hour before the conching is finished. The formulations are shown in Table 8.

Table 8

Formulation	17a	17b	17c	17d	17e	17f
<u>Ingredients</u>	<u>grams</u>	<u>grams</u>	<u>grams</u>	<u>grams</u>	<u>grams</u>	<u>grams</u>
Chocolate liquor	208.7	208.7	208.7	208.7	208.7	208.7
Maltitol	215.0			175.0		
Lactitol		145.0				214.5
Mannitol			130.0			
Xylitol		70.0	85.0	40.0		
Isomalt						214.5
Cocoa butter	23.2	23.2	23.2	23.2	23.2	23.2
MCC/Surfactant	50.6	50.6	50.6	50.6	50.6	50.6
Lecithin	2.5	2.5	2.5	2.5	2.5	2.5
Aspartame®					0.5	
Acesulfame K®						0.5

Example 18 (a-f)

Batch Preparation of Dark Chocolate Having a Fat Content of ~27% and
Reduced Calorie Content by Replacing Sugar with Lower Calorie
Ingredients

The procedure of Example 13 is followed in the batch preparation of the dark chocolate formulations having reduced calorie content by replacing sugar with additional lower calorie sweeteners. The only exception is that Aspartame®, a product of G. D. Searle, is added one hour before the conching is finished. These formulations are shown in Table 9.

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Table 9

Formulation	18a	18b	18c	18d	18e	18f
<u>Ingredients</u>	<u>grams</u>	<u>grams</u>	<u>grams</u>	<u>grams</u>	<u>grams</u>	<u>grams</u>
Chocolate liquor	208.7	208.7	208.7	208.7	208.7	208.7
Maltitol	104.5	104.5			94.5	94.5
Lactitol			94.5			
Sorbitol				94.5		
Raftiline®	110.0	110.0				
Litesse®			120.0	120.0	120.0	120.0
Cocoa butter	23.2	23.2	23.2	23.2	23.2	23.2
MCC/Surfactant	50.6	50.6	50.6	50.6	50.6	50.6
Lecithin	2.5	2.5	2.5	2.5	2.5	2.5
Aspartame®	0.5		0.5	0.5	0.5	
Acesulfame K®		0.5				0.5

Example 19 (a-d)

5 Batch Preparation of Dark Chocolate Having a Fat Content of ~27% and Reduced Calorie Content by Replacing Cocoa Butter with Lower Calorie Ingredients

The procedure of Example 13 is used to prepare the dark chocolate formulations, replacing cocoa butter with fat substitutes having lower calorie content or alternate calorie metabolism with the following modifications.

10 One exception is that the tempering process is modified to account for the presence of the fat substitutes. The other exception is that Aspartame®, a product of G. D. Searle, is added one hour before the conching is finished.

15 These formulations are shown in Table 10.

Table 10

Formulation	19a <u>grams</u>	19b <u>grams</u>	19c <u>grams</u>	19d <u>grams</u>
Chocolate liquor	42.0	42.0	42.0	42.0
Caprenin®	100.0		100.0	
MCT(M5/C10)		100.0		100.0
Maltitol	94.5	94.5	104.5	104.5
Lactitol				
Raftiline®			110.0	110.0
Litesse®	120.0	120.0		
Cocoa powder	90.0	90.0	90.0	90.0
MCC/Surfactant	50.5	50.5	50.5	50.5
Lecithin	2.5	2.5	2.5	2.5
Aspartame®	0.5	0.5	0.5	0.5

Example 20 (a-b)Batch Preparation of Reverse Phase Crisp, Dark Chocolate

5

In a 1200 mL beaker 375.6 grams of sugar is dissolved in 75.1 grams of water with heating to the boiling point. When all of the sugar is dissolved, 93.9 grams of 42DE corn syrup is added, and this is followed in succession by 4.70 grams of lecithin, 375.6 grams of chocolate liquor, and 75.1 grams of cocoa butter. This mixture is emulsified using a Silverson turbine mixer. After emulsification and, if necessary, homogenization, the mixture is poured into a shallow tray and dried under a vacuum of 635-771 mm (25-28 inches) of mercury at a platent temperature of 71.1-76.7°C (160-170°F) until the moisture content of the product is less than 3%. The product is then cut into smaller pieces to be consumed. The formulations of reverse phase, crisp, dark chocolate are shown in Table 11.

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Table 11

Formulation	20a	20b
<u>Ingredients</u>	<u>grams</u>	<u>grams</u>
Chocolate liquor	375.6	375.6
Sugar	375.6	375.6
42DE Corn syrup	93.9	93.9
Cocoa butter	75.1	
Lecithin	4.7	4.7
MCC/Surfactant		75.1
Water	75.1	75.1
Fat content	27%	20%

Example 21 (a-b)

Batch Preparation of Reverse Phase, Crisp, Milk Chocolate

5 In a large vessel is placed 750 grams of sweetened condensed milk heated to 60°C (140°F), and to this are added with mixing 105 grams of chocolate liquor, 90 grams of cocoa butter, 45 grams of 42DE corn syrup, and 3.75 grams of lecithin. After being mixed completely, the mixture is
 10 emulsified with a Silverson turbine mixer. After emulsification and, if necessary, homogenization, the mixture is poured into a shallow tray and dried under a vacuum of 635-771 mm (25-28 inches) of mercury at a platen temperature of 71.1-76.7°C (160-170°F) until the moisture content of the product is less than 3%. The foamed product is then cut into smaller pieces
 15 to be consumed. The formulations of reverse phase, crisp, milk chocolate are shown in Table 12

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Table 12

Formulation	21a	21b
<u>Ingredients</u>	<u>grams</u>	<u>grams</u>
Chocolate liquor	105.0	105.0
Sweetened condensed milk	750.0	750.0
42DE Corn syrup	45.0	45.0
Cocoa butter	90.0	
Lecithin	3.75	3.75
MCC/Surfactant		90.0
Fat content	21%	13%

Example 22

5 Batch Preparation of White Chocolate Having a Fat Content of ~27% Using
Coprocessed Microcrystalline Cellulose/Surfactant Ingredients

In a Brabender Prep Center Sigma® mixer heated to 56°C (132.8°F) are placed 115 grams of milk powder and small amounts of cocoa butter and premilled sugar (approximately 4X from Wilbur Chocolate Co.). This 10 combination is mixed for 15 minutes at 75 rpm after which a preblend of coprocessed F006 microcrystalline cellulose/S570 sucrose monostearate and the remaining sugar (total sugar amount = 237 grams) is added and mixing is continued until a uniform mixture is obtained. In some cases it is necessary to add a small portion of cocoa butter and/or lecithin to improve 15 the mixing. This mixture is then milled twice on a Day 5" x 12", 3-roll refiner with the rolls adjusted to deliver a mass having a uniform particle size of 20 microns. The mixture is then returned to the Brabender Sigma Mixer heated to 56°C (132.8°F) and operating at 25 rpm. A small amount of 20 cocoa butter may be added at this time to facilitate mixing. The dry conch period begins when small dough balls appear in the mixture and continues for two hours. Wet conch begins at the conclusion of this two hour period in the same mixer. The speed is set at 45-50 rpm, and a predispersion of 2.50 grams of lecithin in cocoa butter and the remaining cocoa butter (total cocoa butter content = 95 grams) is added to the mixture. The amounts of 25 cocoa butter and lecithin are reduced by any amount that has been

introduced into the mixture during mixing or the dry conch step. After mixing has been completed, the speed of the mixer is maintained at approximately 20-45 rpm at which time the wet conch begins and continues for a period of two hours. At the conclusion of the conching the mass is

5 removed from the Brabender Sigma Mixer. When the chocolate reaches a temperature of 48.9°C (120°F), two-thirds of the chocolate is poured onto a marble table for tempering. During this step a thin layer (approximately 6-7 mm thick) of chocolate is worked back and forth to crystallize the cocoa butter. When the tempered chocolate cools to 26.7-27.8°C (about 80-

10 82°F), it is mixed vigorously with the remainder of the chocolate mixture that has not been tempered. The final temperature of the entire mixture is 28.9-30°C (about 84-86°F). At this point the chocolate is poured into molds which are tapped to remove air bubbles. The molded chocolate is cooled quickly to 18.3°C (65°F) and then stored at 21.1°C (70°F) and 50% relative

15 humidity until it is evaluated.

Example 23 (a-b)

Batch Preparation of Milk Crumb Containing Microcrystalline Cellulose
Coprocessed with Surfactants

20 In a Brabender Prep Center Sigma® mixer heated to 73°C (163.4°F) are placed 405.45 grams of sweetened condensed milk and 44.55 grams of molten chocolate liquor (West African, medium roast (#1 natural process) from Wilbur Chocolate Co.). The contents are then mixed for approximately

25 30 minutes while operating the mixer at 75 rpm. To this mixture is then added 50 grams of coprocessed F006 microcrystalline cellulose/S570 sucrose monostearate, and mixing is continued at 75 rpm for an additional 30 minutes. This mixture is then emulsified in a Silverson turbine mixer. Upon completion of the emulsification step, the mixture is poured into

30 shallow trays and dried under a vacuum of 635-771 mm (25-28 inches) of mercury at a patent temperature of 71.1°C (160°F) until the moisture content of the product is between 1.5% and 3%. The crisp product may then be pulverized to a powder which subsequently may be used to prepare milk chocolate having reduced fat content by adding 49.3 grams of cocoa

35 butter and 2.3 grams of lecithin to 448.4 grams of milk crumb and

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processing this mixture according to the method of Example 13. Two formulations of milk crumb containing coprocessed microcrystalline cellulose are shown in Table 13.

5

Table 13

Formulation	23a	23b
<u>Ingredients</u>	<u>grams</u>	<u>grams</u>
Chocolate liquor	44.55	44.55
Sweetened condensed milk	405.45	
Sweetened condensed skim milk		405.45
MCC/Surfactant	50.00	50.00

We Claim:

1. A reduced calorie chocolate confection, characterized by 15 to 30 weight percent fat, 3 to 30 weight % of a cellulose/surfactant composite, 5 and 0.5 to 50 weight % sweetener.
2. The reduced calorie chocolate confection of Claim 1 characterized in that there is 20 to 28 % fat; 10 to 30 % composite; and wherein the sweetener is an alternate sweetener.
10
3. The reduced calorie chocolate confection of Claim 2 characterized in that there is 24 to 27 % fat; 10 to 30% composite and the composite contains microcrystalline cellulose; and 0.5 to 40% alternate sweetener.
4. The reduced calorie chocolate of Claim 2 characterized in that the total calories of the chocolate confection is within the range of from 180 to 15 415 calories per 100 grams of the confection.
5. The reduced calorie confection of Claim 4 characterized in that the 20 total calories of the chocolate confection is within the range of from 180 to 220 calories per 100 grams of the confection.
6. A reduced calorie chocolate confection having a fat, a hydrophobic composite of a microcrystalline cellulose/surfactant and a sweetener, the 25 reduced calorie chocolate confection having from 180 to 220 calories per 100 grams.
7. A chocolate crumb containing hydrophobic composite of cellulose coprocessed with a surfactant, as a fat replacement.
30
8. A reverse phase chocolate containing a hydrophobic composite of a coprocessed cellulose/surfactant.

INTERNATIONAL SEARCH REPORT

International application No.
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A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) : A23G 3/00

US CL : 426/660

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 426/631, 602, 613, 660, 804

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

APS

search terms: chocolate, microcrystalline cellulose, confection

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A,P,&	US, A, 5,441,753 (MCGINLEY ET AL) 15 August 1995.	1-8
A	US, A, 5,080,920 (TAYLOR ET AL) 14 January 1992.	1-8
A	US, A, 4, 810, 516 (KONG-CHAN) 07 March 1989.	1-8

 Further documents are listed in the continuation of Box C.

See patent family annex.

* Special categories of cited documents:	T	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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E earlier document published on or after the international filing date	Y	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
L document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reasons (as specified)		document member of the same patent family
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P document published prior to the international filing date but later than the priority date claimed		

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